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Final Report for Purchase Order S-97228-E

Title: Beryllium and Boron Abundances in Population II Stars

The scientific focus of this program was to undertake UV spectroscopic abundance analyses of extremely metal poor stars with attention paid to determining abundances of light elements such as Beryllium and Boron. The abundances of these elements are likely to reflect primordial abundances within the early galaxy and help to constrain models for early galactic nucleosynthesis. The general metal abundances of these stars are also important for understanding stellar evolution.

Due to observing time constraints imposed by the peer review panel, only one of the program stars was observed by IUE. The star chosen for observation at high dispersion in the LWP camera was HD 52961, a recently discovered peculiar F-type supergiant with a reported metallicity of [Fe/H] = -4.8, the most extremely metal poor star identified in the galaxy. Subsequent analysis of the high dispersion spectrum revealed only upper limits on the Be and B abundances but did yield measurable lines of other atomic species. An abundance analysis was performed and published in the proceedings of "Frontiers of Space and Ground Based Astronomy", 1994, and a copy of the article is attached to the report. Although Be and B were not detected in the original LWP high dispersion spectrum (see attached Figures 1 and 2). It is hoped that improved processing of the IUE images in the IUE final archive project will increase the signal to noise ratios in the spectra allowing a detection. Other sources of funding will be used to support the future analysis of the final archive data.

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THE ULTRAVIOLET SPECTRUM OF AN EXTREMELY METAL DEFICIENT STAR: HD 52961

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Abstract. We report on an LTE model atmosphere analysis of the UV spectrum of the extremely metal-poor F-type supergiant HD 52961.

1 Introduction

The peculiar F-type supergiant, HD 52961, was identified in a search for SAO stars with infrared excess indicative of circumstellar material by Oudmaijer et al.(1992) using the IRAS Point Source Catalog. An analysis of its optical spectrum has shown that this star is a luminous, extremely metal-poor object ([Fe/H] = -4.8), with substantially enhanced C,N,O, and S abundances relative to Fe (Waelkens et al., 1991). These results along with others have led to suggestions in the literature that HD 52961 is a peculiar post-AGB star whose abundance anomalies are caused by a depletion of the low abundance elements on to dust grains (eg. Mathis and Lamers, 1992). We have obtained high resolution spectra of this unusual star with the *International Ultraviolet Explorer (IUE)* satellite in the range 2200-3200 angstroms and apply an LTE model atmosphere/spectrum synthesis analysis to determine photospheric abundances from the UV spectrum.

2 Analysis

The *IUE* data was compared to Kurucz LTE model atmosphere fluxes, normalized to the observed V magnitude of 7.4. Examples of the comparisons at both low and high resolution are shown in the accompanying figures.

3 Results

This analysis finds that the UV spectrum of HD 52961 is consistent with a Teff=6000K, log(g)=0.5 LTE model atmosphere. Further, Fe and Mg (along with Cr, V, and other metals with lines in the UV) have a general range in abundance, [A/H], of -3.5 to -4.0. Also, the C I feature illustrated indicates [C/H] = -1.0. These results show Fe and other metals are at least an order of magnitude more abundant than indicated by the optical spectrum, while the [C/H] abundance determined here is slightly less. Reasons for the large discrepancy between the optical and UV

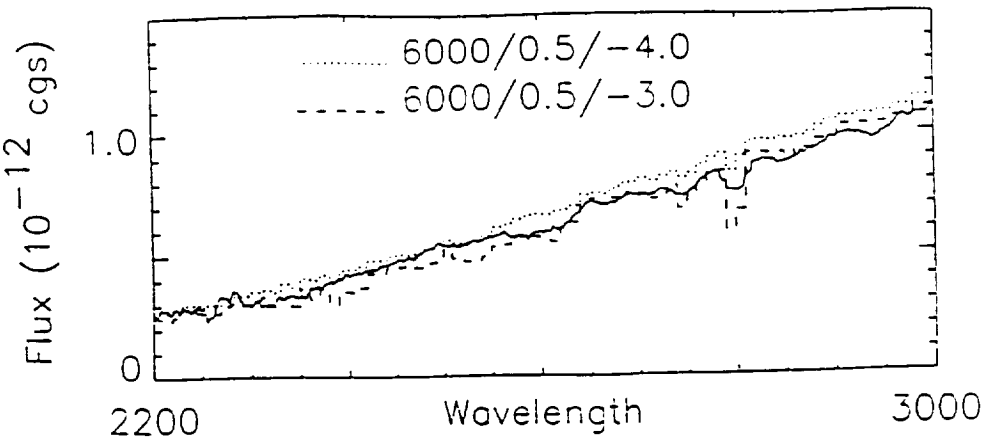

Fig. 1. This figure shows the high dispersion data binned to low dispersion and compared to LTE model atmosphere fluxes. The solid line represents the data. The Kurucz model atmosphere fluxes are labeled by the notation Teff/Log(g)/[A/H] and have been normalized to the observed V magnitude.

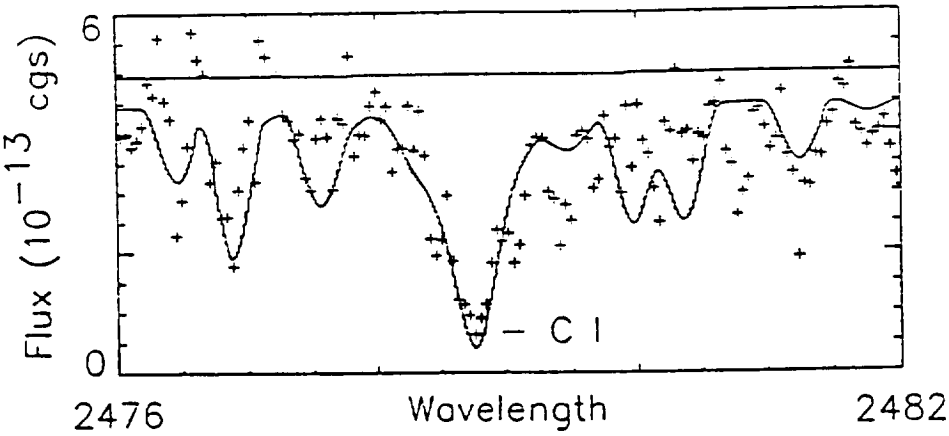

Fig. 2. This figure shows the comparison of high dispersion data to spectrum synthesis results for a 6000/0.5/-3.5 model using [C/H] = -1.0 around the region of the C I line at 2478.5 Å. The solid lines represent the continuum and line fluxes from the spectrum synthesis while the "+" symbols indicate the observed fluxes. Features surrounding the C I line are due to Fe I and Fe II.

abundance analyses are not presently understood but may be related to non-LTE effects. However, the basic pattern of the peculiar chemical abundances of HD 52961 are supported by this analysis of the UV spectrum.

References

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Oudmaijer, R.D., van der Veen, W.E.C.J., Waters, L.B.F.M., Trams, N.R., Waelkens, C., and Engelsman, E., 1992, A&A Suppl., 96, 625.
Waelkens, C., Van Winckel, H., Bogaert, E., and Trams, N., 1991, A&A, 251, 495.

FIGURE 2

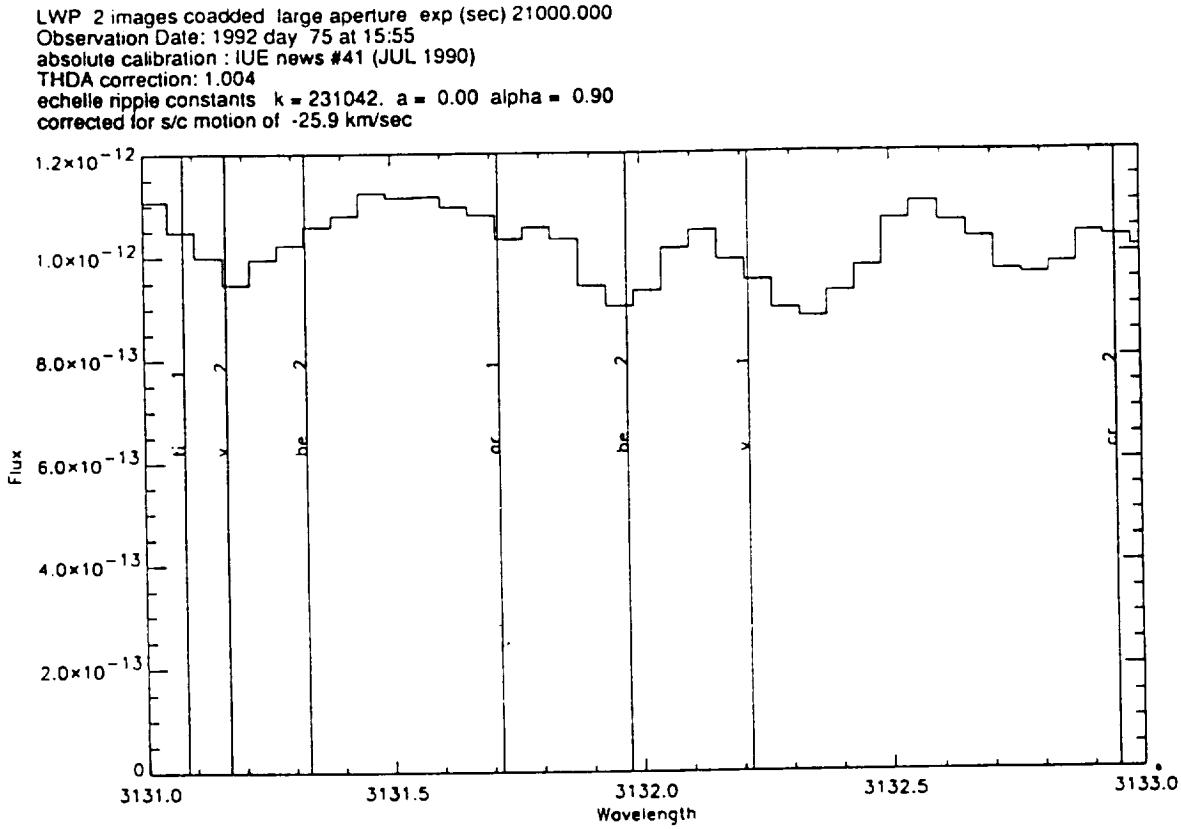

FIGURE 1